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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of the absolute regional temperature potential" *by* D. T. Shindell

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This is a relevant and interesting article, and should be published after appropriate modifications. In a few places the paper lacks some explanations and can be a little misleading at times. I would also like to see a few more tables showing the ARTP, k values, RTP, etc, so one can follow how the calculations were done. My comments are outlined in the following:

âĂć The title and abstract talk about the ARTP, but the article seems to focus more on the RTP (it took me a while to realise this!).

âĂć The introduction constantly seems to interchange between RTP and ARTP as though they are synonyms. E.g., RTP not defined page 13814, line 22. Page 13815,

lines 3 and 4, lines 8-15.

âĂć Page 13814, line 18: It is implicitly implied that the ARTP is only defined for latitude bands, but I presume this is not a necessary restriction? Perhaps relevant to be a little more general? E.g., drop "(latitude bands)" and later add "...Shindell and Faluvegi (2010) developed the ARTP for latitude bands..."

âĂć Page 13815, line 22: This appears to be a definition, but then it uses the word "essentially". Is this the definition or not? Perhaps at the state of the section define clearly "The ARTP is defined as..." Additionally, add somewhere "RTP is defined as..."

âĂć Page 13816, line 7: "kx,y is the dimensionless coefficient relating temperature response in area y to forcing in area x (Table 1)", but Table 1 says "RTP ... regional response per Wm−2 forcing in the indicated area relative to global sensitivity". Is this an ARTP versus RTP issue, or one is k and one is RTP?

âĂć I presume that we cannot back calculate the k's as we do not have the forcing, in that case, I think it is quite valuable to have tables with k, F, ARTP, RTP. It is nice to be able to see how the calculations fit together, and how the numbers are taken from Shindell and Faluvegi.

âĂć Page 13816: The scaling of the IRF is a little misleading. It assumes that the time constants are the same in GISS and HadCM3. It also gives the perception that a climate model is only dictated by a single parameter, the sensitivity, when even when it is expressed as the HadCM3 IRF 4 parameters are required. Additionally, the paper focuses on short-lived components, and in this case the short time constant may be more important than the sensitivity. I am not sure it is feasible, but a better approach would be to take a some parameters from the GISS model that link to a 2-box energy balance model (e.g., see Berntsen and Fuglestvedt PNAS 2008, Supporting Information). Given the IRF will probably make a small difference to the results, I think it is better to use the HadCM3 IRF than to give the perception one can do a simple scaling to have whatever climate model they want.

âĂć Page 13816, lines 18+: “approximate equilibrium response, or transient response. . .” and then an equation line 24. This is a little confusing. You mean the “climate sensitivity” here is either equilibrium or transient, depending on what you want? Perhaps split this into two sentences or make this more explicit. Also the text “(the first term above)” refers to what first term? I am also not sure why we need the Equation on line 24. Is it used later in the article? It also assumes an infinite time horizon (at least very large?), and is this what you are proposing?

âĂć Page 13817, line 1: I suggest to make the “As with” a new paragraph as it is changing topic quite a bit

âĂć Page 13817, line 3: Perhaps be a bit more explicit on the CO2 case. What would the k’s be?

âĂć Page 13817, line 7-8: Is this definition of k (or RTP?) consistent with the previous?

âĂć Page 13817, line 9: “normalises” what? ARTP? Or k? There seems to be a set of k in K/(W/m2) and a set of k normalised to the global mean (0.91)? One for CO2 and one for the species? If so, perhaps distinguish clearly as ka and kco2, ARTPa and ARTPco2, etc.

âĂć Page 13817, line 20: The row sums do not add to the global, as you mention later due to nonlinearities. You also mention that this is only done for comparisons? In any case, how can half the 158% be in the Artic when the row sums do not add? How do I allocate the difference? Or should the comparison be done with the some of the rows?

âĂć How do I use the values? o If I have a 1 W/m2 forcing in the Arctic, then the temperature response in the Arctic is 0.77 the global mean? If the global mean is 0.91K per 1W/m2 (global forcing), then the temperature response in the Arctic is 0.77*0.91=0.70K/(W/m2)? o If I have a 1 W/m2 global forcing, then the temperature response in the Arctic is 1.70 (row sum) or 1.58? Which do I take? In K/(W/m2) this would be 1.55 or 1.44? o These values are all only relative to the global means, and

thus they would scale to a GTP? For example, If I had an emission in a given region, then the response in another region would be RTP*GTP?

âĂć At the start of section 2 it says “ARTP was developed as an analogue to the AGTP”. While this may be the case, it can also be a little confusing. The AGTP converts emissions to a response, whereas most of the discussion around the ARTP is from forcing to response (even though emissions are just as easy mathematically). The RTP, however, seems quite different to the GTP. The RTP seems more concerned with relative difference between regions. It seems I would not take an RTP value and multiply it by an emission to get a CO2-eq emission? Perhaps I would do RTP*GTP*emissions? In any case, it would be useful to discuss these subtleties on how to use the values you have presented.

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